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(54) VEHICLE DRIVE SYSTEM CONTROLLER

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(57) **ABSTRACT**

A drive system controller that improves the level of security for a vehicle. A main microcomputer activates an image recognizer when wireless communication is established with a portable device. The image recognizer images a vehicle occupant to generate image data and uses the image data to verify whether the vehicle occupant is an authorized user. The main microcomputer enables the starting of the engine when wireless communication with the portable device is established and the image recognizer verifies that the vehicle occupant is an authorized user.

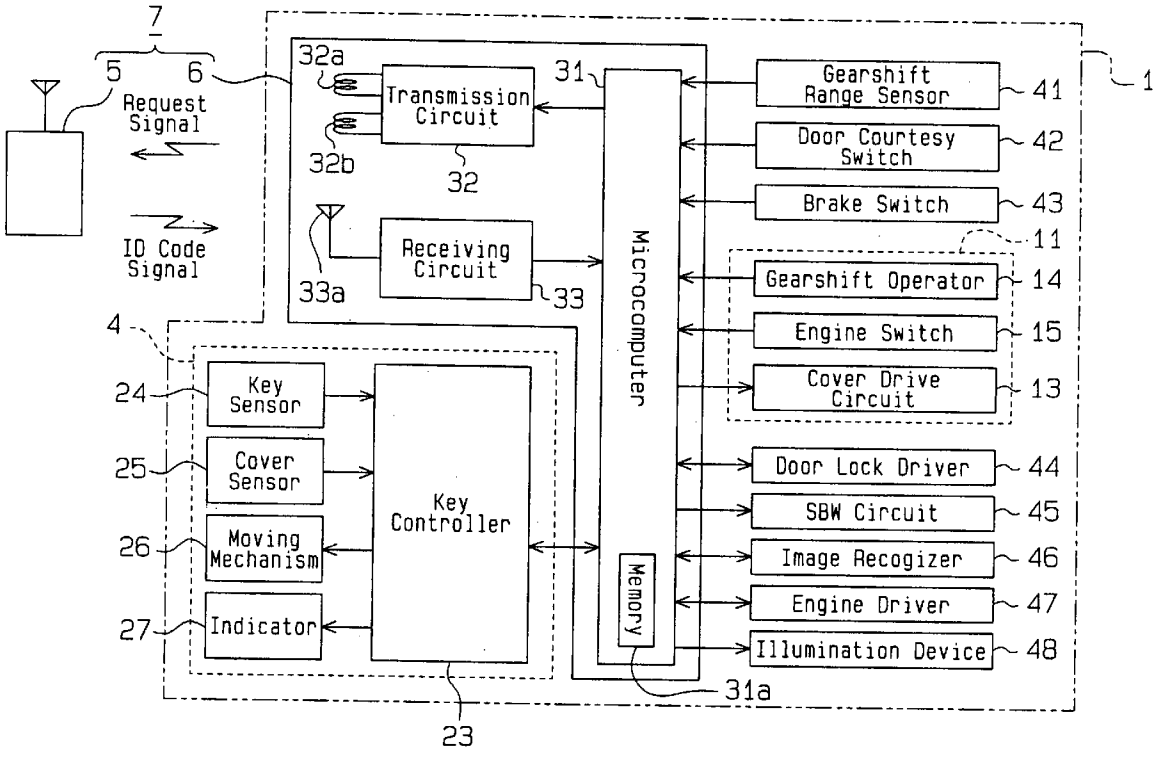


Fig.1

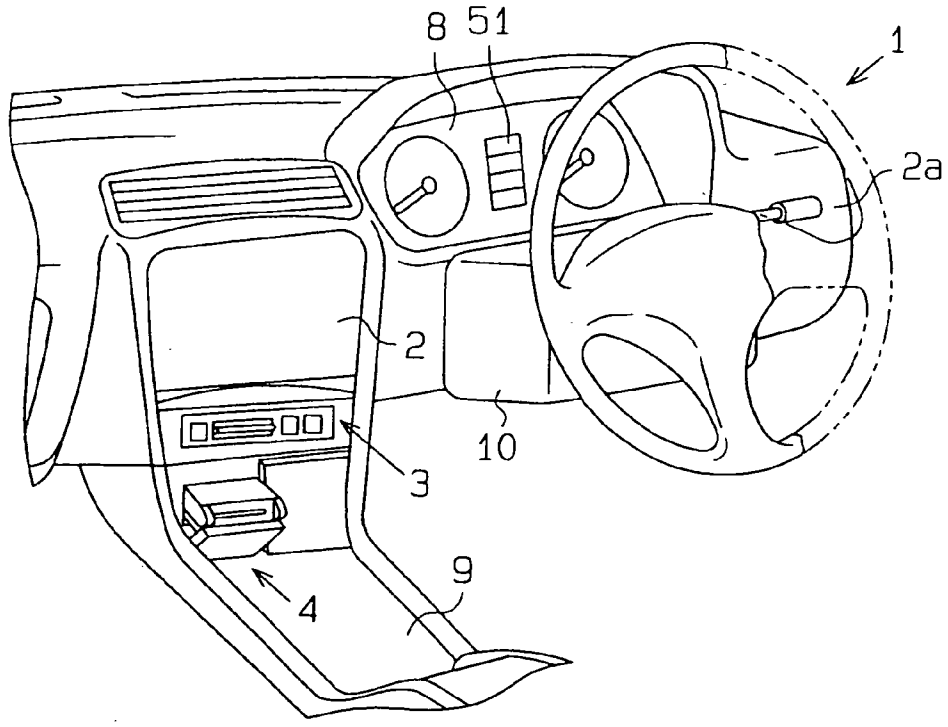


Fig.2

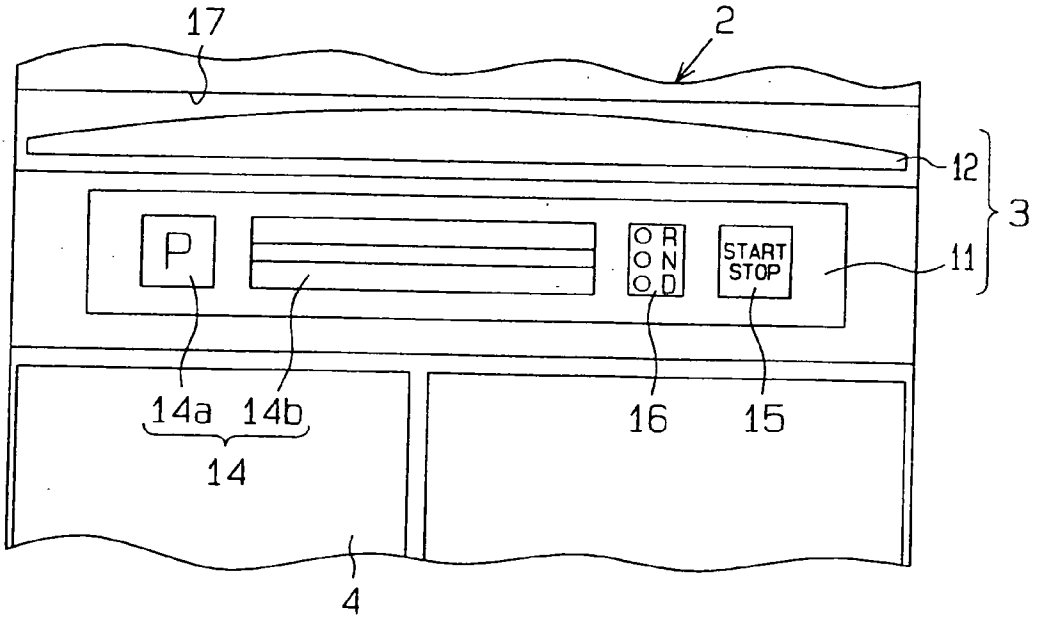


Fig.3A

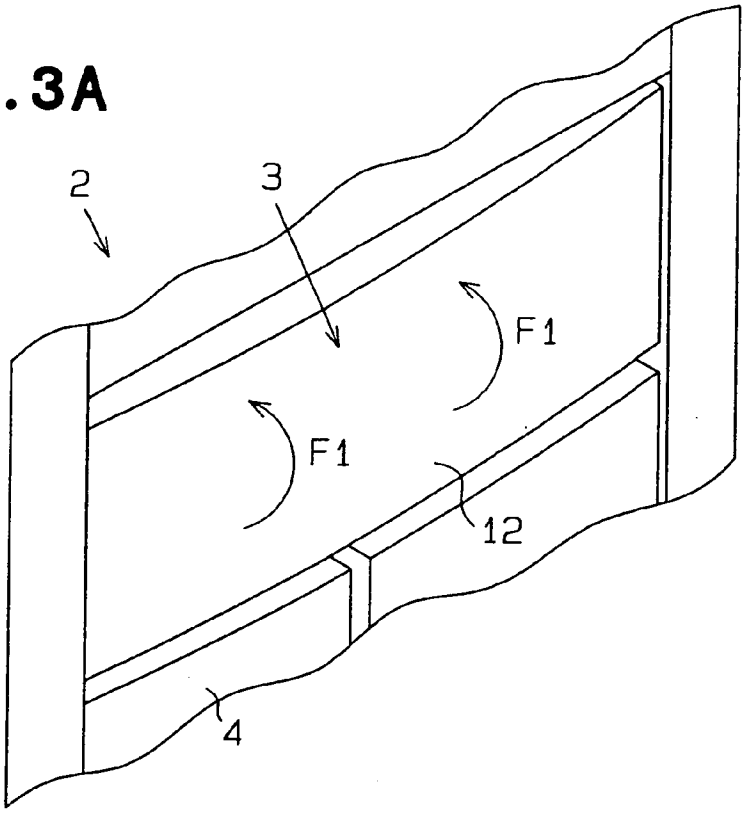


Fig.3B

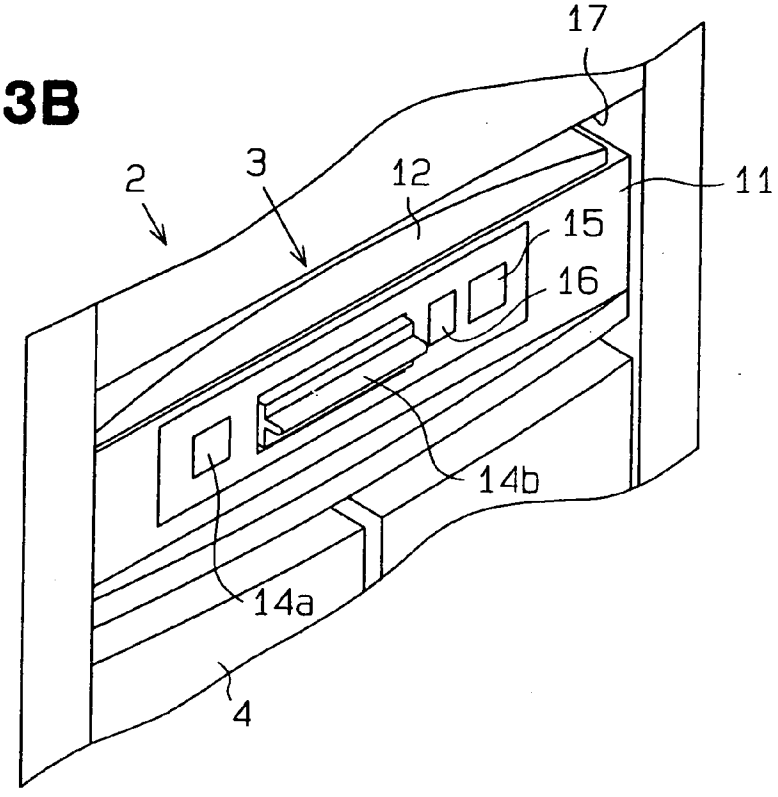


Fig 4A

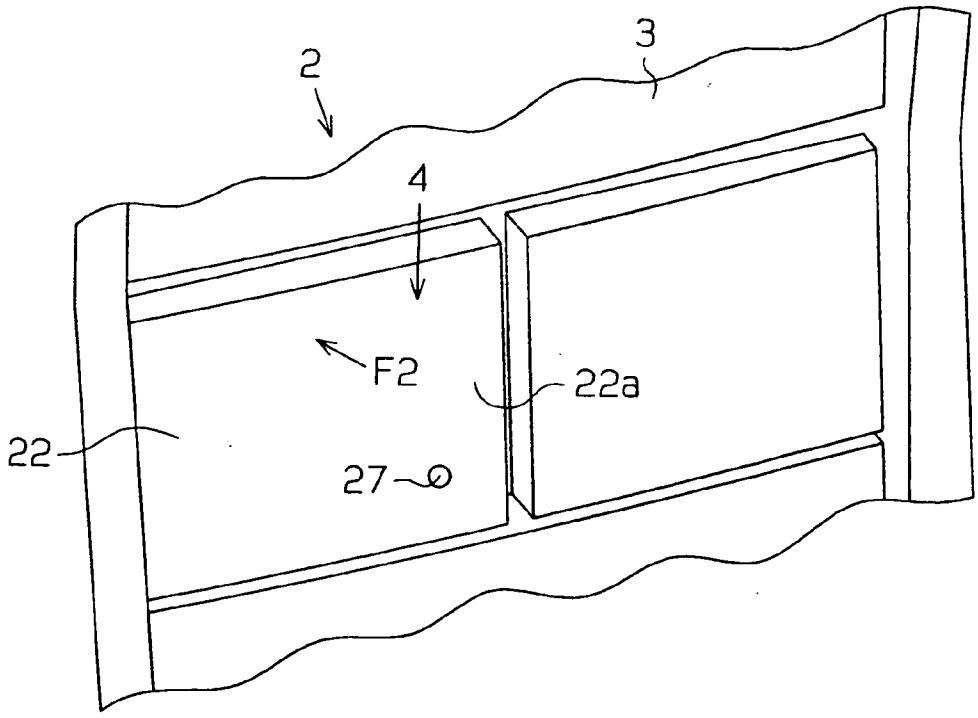
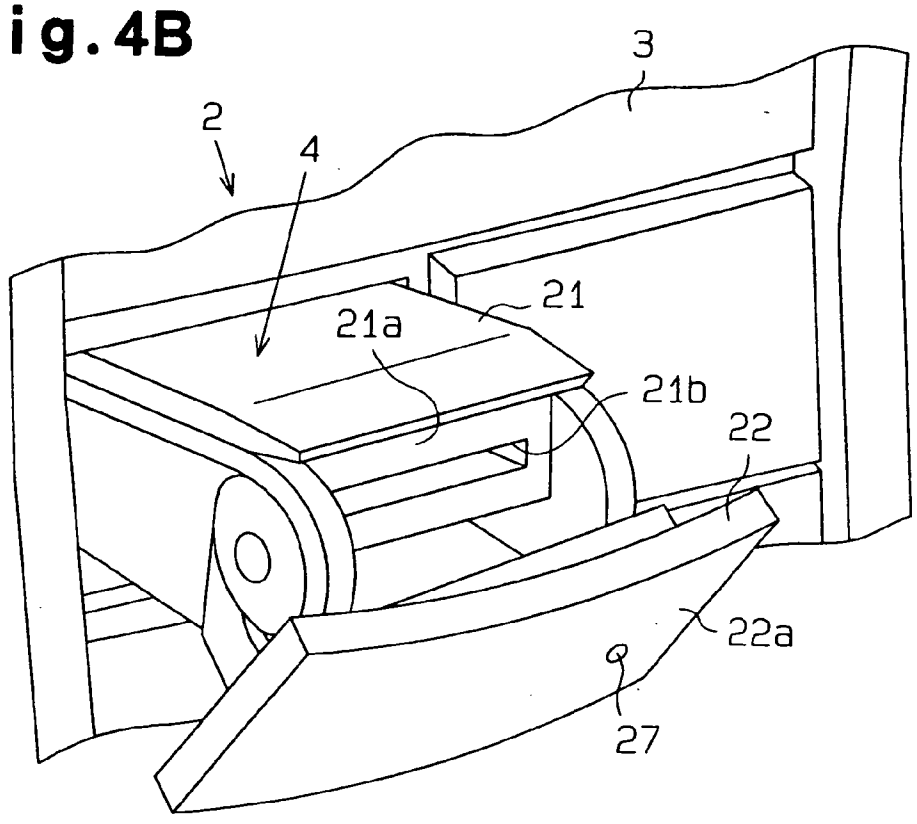
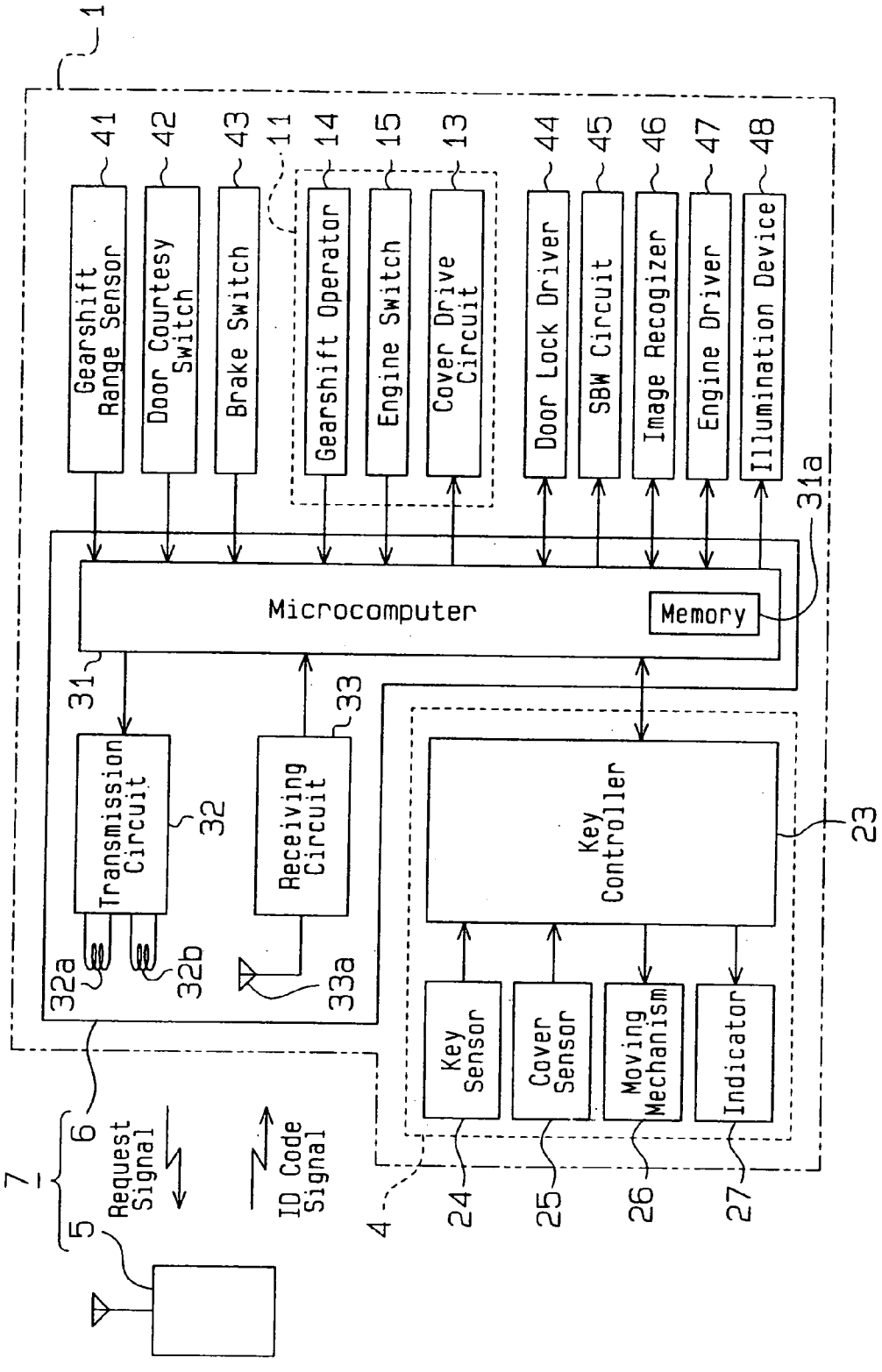


Fig.4B

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41
42
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11
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15
13
44
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46
47
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Gearshift Range Sensor
Door Courtesy Switch
Brake Switch
Gearshift Operator
Engine Switch
Cover Drive Circuit
Door Lock Driver
SBW Circuit
Image Recogizer
Engine Driver
Illumination Device
31a
Microcomputer
Memory
31
33
Transmission Circuit
32
Receiving Circuit
Key Controller
23
32a
32b
33a
Key Sensor
Cover Sensor
Moving Mechanism
Indicator
6
7
5
Request Signal
ID Code Signal
4
24
25
26
27

Fig.5

Fig. 6

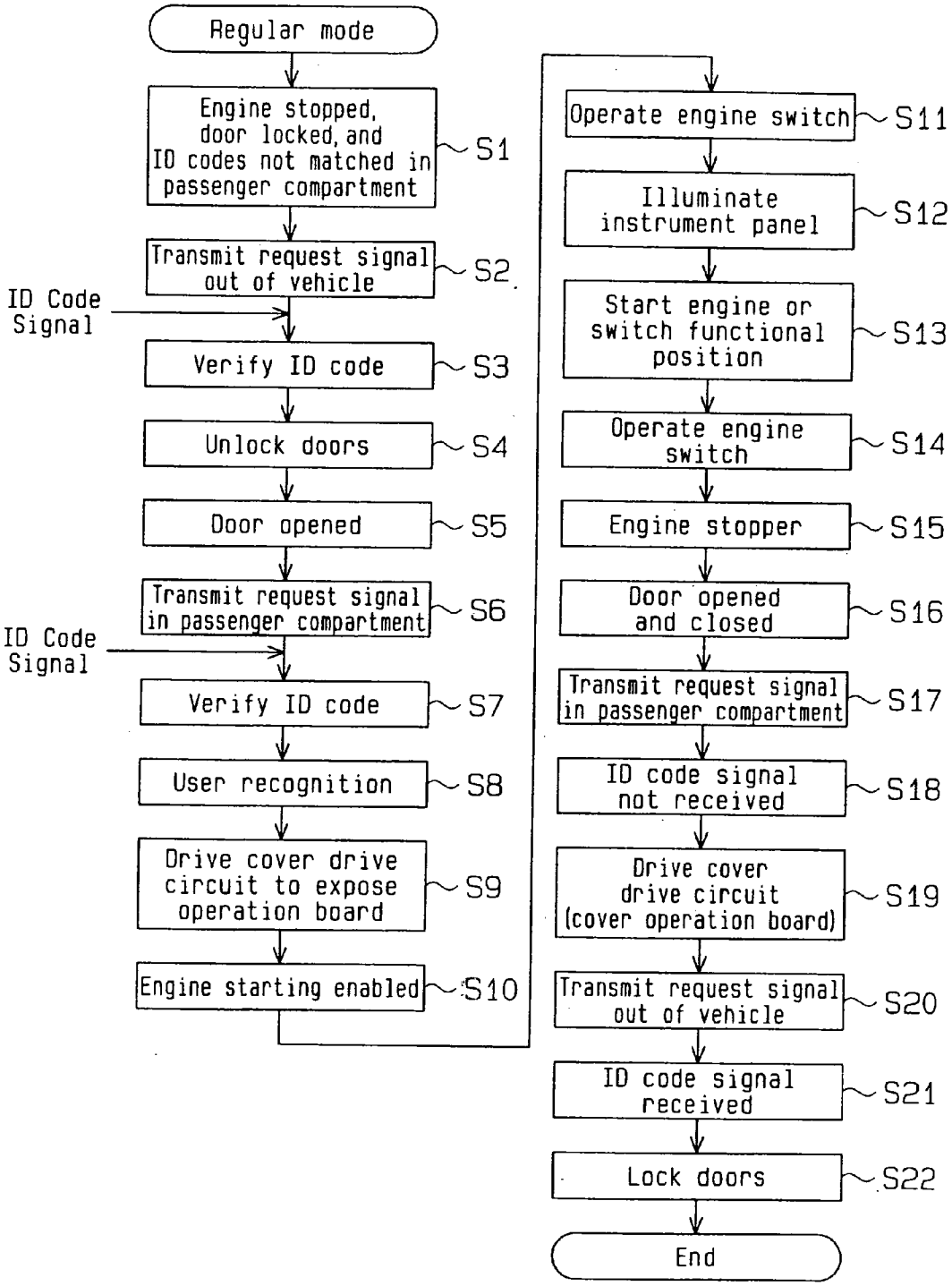
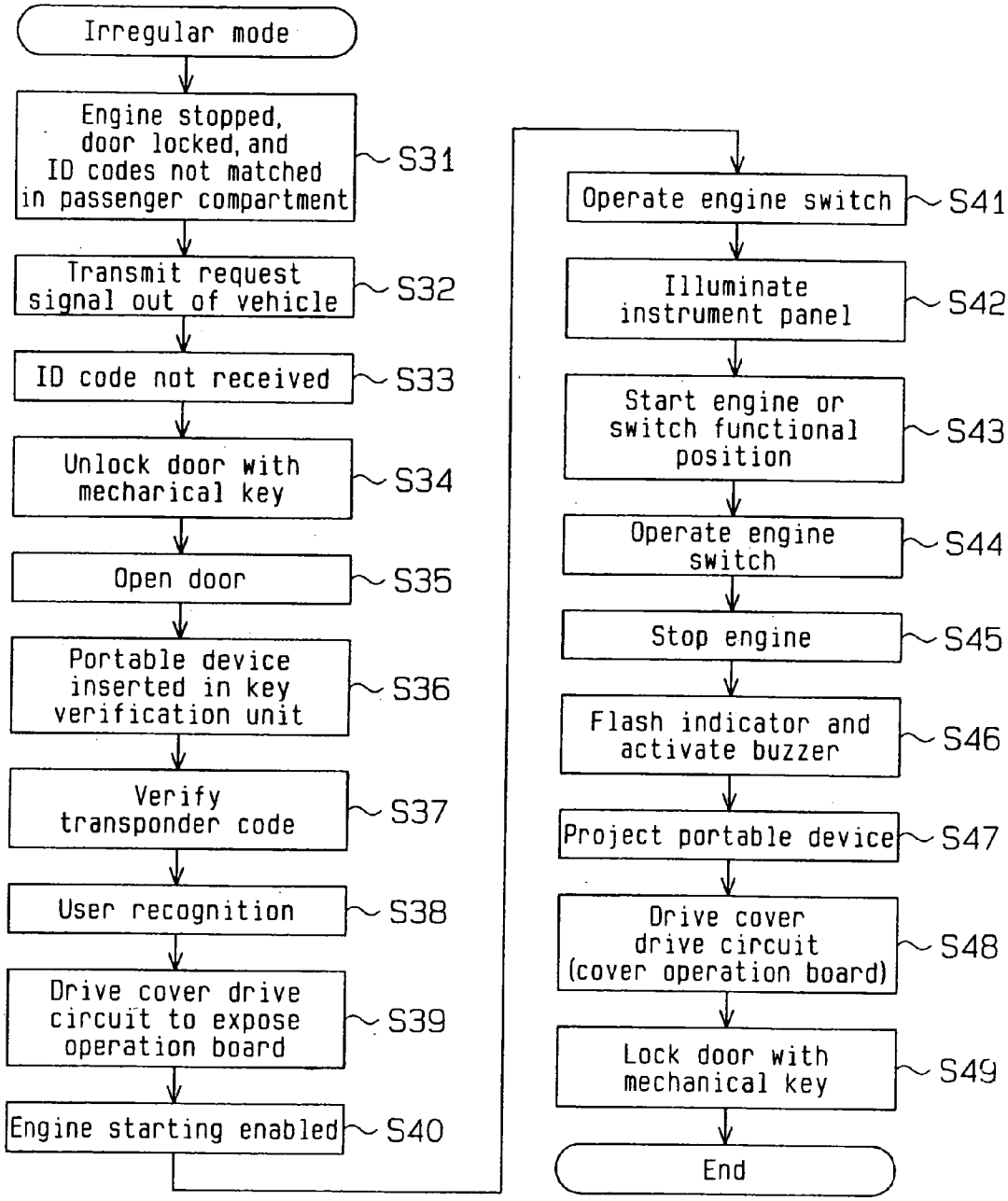

Regular mode
Engine stopped, door locked, and ID codes not matched in passenger compartment
S1
Transmit request signal out of vehicle
S2
ID Code Signal
Verify ID code
S3
Unlock doors
S4
Door opened
S5
Transmit request signal in passenger compartment
S6
ID Code Signal
Verify ID code
S7
User recognition
S8
Drive cover drive circuit to expose operation board
S9
Engine starting enabled
S10
Operate engine switch
S11
Illuminate instrument panel
S12
Start engine or switch functional position
S13
Operate engine switch
S14
Engine stopper
S15
Door opened and closed
S16
Transmit request signal in passenger compartment
S17
ID code signal not received
S18
Drive cover drive circuit (cover operation board)
S19
Transmit request signal out of vehicle
S20
ID code signal received
S21
Lock doors
S22
End

Fig.7


Irregular mode
Engine stopped, door locked, and ID codes not matched in passenger compartment
S31
Transmit request signal out of vehicle
S32
ID code not received
S33
Unlock door with mechanical key
S34
Open door
S35
Portable device inserted in key verification unit
S36
Verify transponder code
S37
User recognition
S38
Drive cover drive circuit to expose operation board
S39
Engine starting enabled
S40
Operate engine switch
S41
Illuminate instrument panel
S42
Start engine or switch functional position
S43
Operate engine switch
S44
Stop engine
S45
Flash indicator and activate buzzer
S46
Project portable device
S47
Drive cover drive circuit (cover operation board)
S48
Lock door with mechanical key
S49
End

VEHICLE DRIVE SYSTEM CONTROLLER

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a method for improving the level of security in a vehicle, and more particularly, to a controller for controlling the starting and stopping of an engine.

[0002] A conventional vehicle key is inserted in a key cylinder, which is arranged on a steering column. A driver turns the vehicle key and moves the key cylinder between functional positions to start and stop the engine. However, in such prior art mechanical key systems, the engine may be started or stopped by using a copied key or by picking the lock of the key cylinder. Accordingly, there is a demand for a device that improves the security level of a vehicle.

[0003] Japanese Laid-Open Patent Publication Nos. 2001-289142 and 2001-311333 describe an engine drive control system that performs electronic verification to enable the starting of the engine. This improves the security level of the vehicle. The engine drive control system includes a portable device, which is provided with a communication function, and an engine drive controller, which is installed in the vehicle. The starting of the engine is enabled under the condition that communication is properly established between the portable device and the engine drive controller. When an engine starting switch is operated to start the engine, the engine must be in the state in which starting is enabled. This prevents a third person, who is not carrying the portable device, from starting the engine. This also simplifies the operations for starting the engine since the engine may be started just by operating the engine starting switch.

[0004] However, in such an engine control system, anyone carrying the portable device may start the engine. Thus, when the driver loses the portable device and a third person finds the portable device, the third person would be able to start the engine.

SUMMARY OF THE INVENTION

[0005] Accordingly, it is an object of the present invention to provide a vehicle controller that improves the security level of a vehicle.

[0006] To achieve the above object, the present invention provides a controller of a vehicle having an engine for use with an authorized key having a communication function. The controller includes a microcomputer for controlling the engine. The microcomputer is capable of communicating with the authorized key. A recognizer is activated when predetermined conditions, including establishment of communication between the microcomputer and the authorized key, are satisfied to verify whether a vehicle occupant is an authorized user. The microcomputer enables the starting of the engine when communication is established with the authorized key and the recognizer verifies the vehicle occupant as being the authorized user.

[0007] Another aspect of the present invention is a method for controlling a vehicle having an engine and a door. The method includes transmitting a request signal to a predetermined area defined around the vehicle, unlocking the door when receiving a response signal in response to the request signal, verifying whether a vehicle occupant is an authorized user, and enabling starting of the engine when the vehicle occupant is verified as the authorized user.

[0008] A further aspect of the present invention is a system for controlling an engine of a vehicle having a passenger compartment. The system includes an authorized key capable of wireless communication. A key receiver is arranged in the passenger compartment of the vehicle to receive the authorized key. A recognizer is arranged in the passenger compartment to image a vehicle occupant and verify whether a vehicle occupant is an authorized user. A communication circuit performs wireless communication with the authorized key. A microcomputer is connected to the recognizer and the communication circuit. The microcomputer activates the recognizer when wireless communication is established between the authorized key and the communication circuit, enables starting of the engine when the recognizer verifies that the vehicle occupant is an authorized user, and disables starting of the engine when wireless communication is not established between the authorized key and the communication circuit unless a predetermined condition is satisfied.

[0009] Other aspects and advantages of the present invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The invention, together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

[0011] **FIG. 1** is a perspective view showing a passenger compartment including a drive system operation apparatus and a key holder according to a preferred embodiment of the present invention;

[0012] **FIG. 2** is a front view showing the drive system operation apparatus of **FIG. 1**;

[0013] **FIGS. 3A and 3B** are perspective views showing the drive system operation apparatus of **FIG. 1**;

[0014] **FIGS. 4A and 4B** are perspective views showing the key holder of **FIG. 1**;

[0015] **FIG. 5** is a block diagram showing a vehicle drive control system according to a preferred embodiment of the present invention;

[0016] **FIG. 6** is a flowchart for a regular mode; and

[0017] **FIG. 7** is a flowchart for an irregular mode.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0018] A drive system operation apparatus **3** according to a preferred embodiment of the present invention will now be discussed.

[0019] As shown in **FIG. 1**, an instrument panel **2**, which is arranged in a passenger compartment of a vehicle **1**, includes a vehicle drive system operation apparatus **3** and a key verification unit **4**, which receives an authorized key, or a portable device **5** (refer to **FIG. 5**). It is preferred that the

drive system operation apparatus **3** and the key verification unit **4** be arranged between the driver seat and the passenger seat.

[**0020**] With reference to **FIGS. 2, 3A, 3**B, and **5**, the drive system operation apparatus **3** includes an operation board **11**, a shutter, or a movable operation board cover **12**, and a cover drive circuit **13**. The operation board **11** has an external surface facing towards the driver, and includes a gearshift operator **14**, an engine operator, or engine switch **15** for starting and stopping the engine, and a range indicator **16**. The gearshift operator **14** and the engine switch **15** are located near each other.

[**0021**] The gearshift operator **14** includes a parking switch **14***a* and a gearshift switch **14***b*. It is preferred that the parking switch **14***a* be a momentary type push button switch. Further, it is preferred that the gearshift switch **14***b* be a lever switch that is normally located at a neutral position, moved to an upward position or downward position from the neutral position, and returned to the neutral position from the upward or downward position. The driver operates the parking switch **14***a* or the gearshift switch **14***b* to switch the transmission between gearshift ranges (gearshift ranges P, R, N, and D). For example, when the parking switch **14***a* is operated, the gearshift range of the transmission shifts to the parking (P) range. When the gearshift switch **14***b* is operated, the gearshift range of the transmission is shifted to one of the P range, the reverse (R) range, the neutral (N) range, and the drive (D) range. More specifically, if the parking switch **14***a* is operated when the vehicle velocity is zero and the engine is running, the transmission shifts to the P range regardless of which one of the R, N, and D ranges the transmission is in. When the gearshift switch **14***b* is pushed downward, the gearshift range is shifted in a sequential manner in the order of the P range, R range, N range, and D range. When the gearshift range is pushed upward, the gearshift range is shifted in a sequential manner in the order of the D range, N range, R range, and P range. Shifting from the R range to the P range is enabled only when the vehicle velocity is zero.

[**0022**] A light emitting device, such as an LED, is arranged in the parking switch **14***a*. The light emitting device is illuminated when the transmission is in the P range to highlight the switch **14***a*.

[**0023**] Referring to **FIG. 2**, the letters R, N, and D are marked on the surface of the range indicator **16**. A light emitting device, such as an LED, is arranged next to each letter. When the transmission is in the R range, the N range, or the D range, the light emitting device corresponding to the present gearshift range is illuminated to indicate the present gearshift range. The light emitting device may also illuminate the corresponding letter.

[**0024**] A further light emitting device is arranged in the engine switch **15**. The engine switch **15** is preferably a momentary type push button switch. The engine switch **15** is operated under predetermined conditions to start and stop the engine and to perform shifting between functional positions for an electric system of the vehicle.

[**0025**] The operation board cover **12** covers and exposes the operation board **11**. As shown in **FIG. 3**A, the operation board cover **12** is normally arranged at a closed position where it covers the operation board **11**. The driver cannot operate the operation board **11** when the operation board cover **12** is located at the closed position. When predetermined conditions are satisfied, the cover drive circuit **13** moves and opens the operation board cover **12** in the direction indicated by the arrows F1. As shown in the states of **FIGS. 2 and 3**B, the operation board cover **12** is retained in a retaining space **17** located above the operation board **11**. This exposes the operation board **11**. When the operation board cover **12** is located at this opened position, the driver may operate the operation board **11**. The operation board cover **12** returns to the closed position from the opened position when predetermined conditions are satisfied.

[**0026**] With reference to **FIGS. 1, 3A, 3**B, and **4**, the key verification unit **4** is located under the drive system operation apparatus **3**. As shown in **FIG. 4**B, the key verification unit **4** includes a holder **21** for receiving the authorized key (portable device) **5**, and a movable key cover **22**, which functions as a shutter for the holder **21**.

[**0027**] The holder **21** is movable between a position in which it is accommodated in the instrument panel **2** as shown in the state of **FIG. 4A and a** position in which it is projected from the instrument panel **2** as shown in the state of **FIG. 4B**. Referring to **FIG. 4**B, the holder **21** includes a key receiver **0.21***a*, which has a key slot **21***b*. The portable device **5** is inserted in the key slot **21***b*. The portable device **5** is, for example, card-like shaped.

[**0028**] As shown in the state of **FIG. 4**A, the key cover **22** covers the holder **21** when the holder **21** is accommodated in the instrument panel **2**. The key cover **22** is moved to expose the key receiver **21***a* when the holder **21** is projected from the instrument panel **2**, as shown in the state of **FIG. 4B**. In the preferred embodiment, the key cover **22** may be manually moved. More specifically, in the state of **FIG. 4**A, the key cover **22** is pushed toward the instrument panel **2** in the direction indicated by arrow F2. This opens the key cover **22** to expose the key receiver **21***a* as the holder **21** projects from the instrument panel **2**. In the state of **FIG. 4**B, the key cover **22** is pushed toward the instrument panel **2**. This moves the key cover **22** to close the holder **21** and accommodates the holder **21** in the instrument panel **2**.

[**0029**] Referring to **FIG. 5**, the holder **21** includes a key controller **23**, which controls the retraction and projection of the holder **21**, a key sensor **24**, a cover sensor **25**, and a moving mechanism **26**, which moves the holder **21**. The key sensor **24** detects whether or not the portable device **5** is inserted in the key receiver **21***a*. The cover sensor **25** detects whether the key cover **22** is covering the holder **21**. The moving mechanism **26** moves the portable device **5**, in a state inserted in the key receiver **21***a*, into the holder **21** (retraction) and out of the holder **21** (projection).

[**0030**] The key controller **23** is a microcomputer, which includes a CPU, a ROM, and a RAM, and controls the moving mechanism **26** in accordance with control signals from the key sensor **24**, the cover sensor **25**, and a main microcomputer **31** of a vehicle controller **6**. More specifically, when the key sensor **24** detects the insertion of the portable device **5** in the key receiver **21***a*, the key controller **23** provides the moving mechanism **26** with a retraction drive signal to retract the portable device **5** into the holder **21**. If the portable device **5** is in the retracted state and the holder **21** is not covered when the key controller **23** receives an engine stop signal from the main microcomputer **31**, the

key controller **23** provides the moving mechanism **26** with a projection drive signal to project the portable device **5** from the holder **21**.

[**0031**] Referring to **FIGS. 4A and 4B**, an indicator **27**, which is formed by a light emitting device such as an LED, is arranged on an external surface **22***a* of the key cover **22**. The indicator **27** is electrically connected to the key controller **23**, as shown in **FIG. 5**. The key controller **23** has the indicator **27** indicate that the portable device **5** is in a state held in the holder **21** or inserted in the key receiver **21***a*. In the preferred embodiment, the indicator **27** is continuously illuminated if the portable device **5** is held in the holder **21** when the engine is running. If the portable device **5** is held in the holder **21** or inserted in the key receiver **21***a* when the engine is not running, the indicator **27** flashes and a buzzer (not shown) goes off.

[**0032**] The key verification unit **4** performs transponder communication with the portable device **5** when the portable device **5** is held in the holder **21**. More specifically, the portable device **5** includes a transponder driver (not shown), and the holder **21** includes a transponder communicator (not shown). When the portable device **5** is held in the holder **21**, the transponder communicator, which is located in the key controller **23**, performs communication with the transponder driver of the portable device **5**. As a result, a transponder code stored in the transponder driver is compared with a transponder code stored in the key controller **23**. When the two transponder codes match, the key controller **23** provides the main microcomputer **31** with an electric signal indicating verification.

[**0033**] Referring to **FIG. 5**, the operation board **11** of the drive system operation apparatus **3** and the key verification unit **4** are electrically connected to the vehicle controller **6**, which is installed in the vehicle **1**. The vehicle controller **6** includes the vehicle control main microcomputer **31**, which incorporates a gearshift control circuit, an engine control circuit, and a communication control circuit. The vehicle controller **6** also includes a transmission circuit **32** and a receiving circuit **33**. In the operation board **11**, the cover drive circuit **13**, the gearshift operator **14**, and the engine switch **15** are electrically connected to the main microcomputer **31**. In the key verification unit **4**, the key controller **23** is electrically connected to the main microcomputer **31**. When the gearshift operator **14** and the engine switch **15** are operated, electric signals indicating the operation states of the gearshift operator **14** and the engine switch **15** are provided to the main microcomputer **31**.

[**0034**] A gearshift range sensor **41**, a door courtesy switch **42**, a brake switch **43**, a door lock driver **44**, a transmission driver, or a shift by wire (SBW) circuit **45**, an image recognizer **46** for recognizing whether the vehicle occupant is the authorized user, an engine driver **47**, and an illumination device **48** are electrically connected to the main microcomputer **31**.

[**0035**] The gearshift range sensor **41** is arranged in the transmission (not shown) to detect the present gearshift range of the transmission. The door courtesy switch **42** is arranged in each door of the vehicle **1** to detect the state (opened state and closed state) of the corresponding door. The brake switch **43** detects depression of a foot brake. The door lock driver **44** includes actuators for locking and unlocking the doors and drives the actuators in accordance with an electric signal provided from the main microcomputer **31**. More specifically, the door lock driver **44** drives the actuators to unlock the doors when provided with an unlock command signal from the main microcomputer **31** and drives the actuators to lock the doors when provided with a lock command signal from the main microcomputer **31**. The SBW circuit **45** switches the connection of the transmission in accordance with an electric signal provided from the main microcomputer **31**. More specifically, the transmission includes an actuator that switches the connection of the transmission. The SBW circuit **45** drives the actuator in accordance with the electric signal (drive control signal) from the main microcomputer **31** to switch the connection of the transmission. The image recognizer **46** images the vehicle occupant (e.g., driver) with an imaging device, such as an infrared camera, that is arranged on a rearview mirror (not shown) to generate image data. The image recognizer **46** then determines whether the image data matches reference image data, which is stored beforehand, to perform image recognition. When the image data match, the vehicle occupant is verified as the authorized user. It is preferred that the image recognizer **46** verify the vehicle occupant as the authorized user using distinctive and physical features, such as the face, eyes, hands, and fingerprints of the authorized user.

[**0036**] The image recognizer **46** is activated in response to an activation signal provided from the main microcomputer **31** and provides the verification result to the main microcomputer **31**. The engine driver **47** starts and stops the engine in accordance with an electric signal from the main microcomputer **31**. More specifically, when a predetermined starting operation is performed after the engine driver **47** receives a start enabling signal from the main microcomputer **31**, the engine driver **47** drives a self-starter motor (not shown) and performs fuel injection and ignition to start the engine. The engine driver **47** detects the drive state of the engine in accordance with an ignition pulse and an alternator output. When the engine is running, the engine driver **47** provides the main microcomputer **31** with a combustion signal. When the engine driver **47** is provided with a stop command signal from the main microcomputer **31**, the engine driver **47** stops fuel injection and ignition to stop the engine. Further, the engine driver **47** stops the output of the combustion signal. The illumination device **48** illuminates the headlights, the taillights, the room light, and an instrument panel light for illuminating a combination meter **8** (**FIG. 1**).

[**0037**] Referring to **FIG. 5**, the vehicle controller **6** and the portable device **5** form a vehicle drive control system **7**. When receiving a request signal from the vehicle controller **6**, the portable device **5** modulates an ID code signal (response signal), which includes a predetermined ID code, to a radio wave having a predetermined frequency (e.g., 300 MHz) and automatically transmits the radio wave. In other words, the portable device **5** is provided with a function for communicating with the vehicle controller **6**.

[**0038**] The main microcomputer **31** is electrically connected to the transmission circuit **32** and the receiving circuit **33**. When predetermined conditions are satisfied, the main microcomputer **31** provides the transmission circuit **32** with a request signal. The transmission circuit **32**, which includes an exterior transmission antenna **32***a* and an interior transmission antenna **32***b*, modulates the request signal from the

main microcomputer **31** to a wireless signal having a predetermined frequency (134 kHz) and outputs the wireless request signal from the exterior transmission antenna **32***a* and the interior transmission antenna **32***b*. The exterior transmission antenna **32***a* transmits the wireless request signal to a predetermined first area around the vehicle **1**. The interior transmission antenna **32***b* transmits the wireless request signal to a predetermined second area that includes at least the driver seat in the passenger compartment. In accordance with certain output conditions, the main microcomputer **31** transmits the wireless request signal from either the exterior transmission antenna **32***a* or the interior transmission antenna **32***b*.

[**0039**] The receiving circuit **33** includes a receiving antenna **33***a* for receiving an ID code signal returned from the portable device **5** in response to the request signal. When the receiving circuit **33** receives the ID code signal, the receiving circuit **33** demodulates the ID code signal to generate a received signal and provides the main microcomputer **31** with the received signal.

[**0040**] The main microcomputer **31** includes a central processing unit (CPU), a read only memory (ROM), and a random access memory (RAM), and a non-volatile memory **31***a*. A predetermined ID code is recorded in the memory **31***a*. When the receiving circuit **33** receives the ID code signal from the portable device **5**, the main microcomputer **31** compares the ID code of the ID code signal with the ID code recorded in the memory **31***a* to perform ID code verification. Under the condition that the ID codes match, the main microcomputer **31** controls the cover drive circuit **13**, the door lock driver **44**, the image recognizer **46**, and the illumination device **48**. Based on the processing performed by the main microcomputer **31**, the vehicle **1** enters modes that will now be discussed with reference to the flowcharts of **FIGS. 6 and 7**.

[**0041**] 1. Regular Mode

[**0042**] In step S1 of **FIG. 6**, the engine is stopped, the doors are locked, and the ID codes are not matched in the passenger compartment. In this case, in step S2, the vehicle controller **6** transmits the request signal out of the vehicle **1**. When the portable device **5** receives the request signal, the portable device **5** transmits the ID code signal. In step S3, the vehicle controller **6** verifies the ID code with the main microcomputer **31**. When the ID code of the ID code signal matches the ID code recorded in the memory **31***a* of the main microcomputer **31**, the main microcomputer **31** provides the door lock driver **44** with an unlock drive signal (step S4). Thus, as long as a user is carrying the portable device **5**, the user only has to approach the vehicle **1** and does not have to perform any operations to unlock the doors.

[**0043**] When any of the door courtesy switches **42** detects the operation (opening and/or closing) of the corresponding door in step S5, the vehicle controller **6** outputs the request signal in the passenger compartment in step S6. In other words, when communication with the portable device **5** is established and the doors are unlocked, the vehicle controller **6** determines that communication has been established with the portable device **5** and enters a regular mode. Then, when a door is operated (opened and/or closed), the vehicle controller **6** outputs a request signal in the passenger compartment.

[**0044**] In response to the request signal, the portable device **5** transmits the ID code signal. When the vehicle controller **6** receives the ID code signal, the main microcomputer **31** verifies the ID code in step S7. If the ID code is verified, the vehicle controller **6** performs user recognition with the image recognizer **46** in step S8. More specifically, the main microcomputer **31** provides the image recognizer **46** with an activation signal to perform user recognition with the image recognizer **46**. When the authorized user is confirmed through the user recognition process, the vehicle controller **6** activates the cover drive circuit **13** to expose the operation board **11** in step S9. In other words, when the main microcomputer **31** is provided with an electric signal indicating that the driver has been verified as being the authorized user, the main microcomputer **31** provides the cover drive circuit **13** of the drive system operation apparatus **3** with a drive signal to move the operation board cover **12** and expose the operation board **11** (as shown in the state of **FIG. 3B**). This enables the operation of the gearshift operator **14** and the engine switch **15**. Thus, in the regular mode, the operation board **11** is exposed and the operations of the gearshift operator **14** and the engine switch **15** are enabled when the conditions of communication being properly performed between the portable device **5** and the vehicle controller **6** in the passenger compartment and the authorized user being verified are satisfied. In this manner, the vehicle controller **6** enters a state in which engine starting is enabled in step S10.

[**0045**] When the gearshift operator **14** is operated in this state, a corresponding operation signal is provided to the main microcomputer **31**. In response to the operation signal from the gearshift operator **14**, the main microcomputer **31** provides the SBW circuit **45** with a drive control signal for switching the connection of the transmission to the corresponding gearshift range. Then, the SBW circuit **45** switches the connection of the transmission in accordance with the drive control signal. Thus, the connection of the transmission is switched to a state corresponding to the operation of the gearshift operator **14**.

[**0046**] The main microcomputer **31** does not provide the SBW circuit **45** with the drive control signal when the operation board **11** is in a state covered by the operation board cover **12**. The main microcomputer **31** does not provide the SBW circuit **45** with the drive control signal even if an operation signal is received from the gearshift operator **14** unless the main microcomputer **31** outputs the drive signal for exposing the operation board **11**. In other words, when the main microcomputer **31** is not providing the cover drive circuit **13** with the drive signal that exposes the operation board **11**, the main microcomputer **31** invalidates the operation signal received from the gearshift operator **14**. Thus, even if the gearshift operator **14** is operated in a state in which the operation board **11** is forcibly exposed, such as when the operation board cover **12** is broken, the connection (gearshift range) of the transmission cannot be switched. This improves the antitheft security of the vehicle **1**.

[**0047**] In step S11, if the engine switch **15** is operated in the state in which engine starting is enabled, the corresponding operation signal is provided to the main microcomputer **31**. When receiving the operation signal from the engine switch **15**, the main microcomputer **31** provides the illumination device **48** with an activation signal and illuminates the instrument panel in step S12.

[0048] In the preferred embodiment, if the brake switch **43** is activated when the engine switch **15** is operated, the engine is started in step S**13**. More specifically, if the main microcomputer **31** is provided with a signal from the brake switch **43** indicating that the brake is being depressed when the engine switch **15** is operated, the main microcomputer **31** provides the engine driver **47** with a start signal. In response to the start signal, the engine driver **47** starts the engine.

[0049] If the brake switch **43** is not activated indicating that the brake is not being depressed when the engine switch **15** is operated, the functional positions of the electric system in the vehicle **1** is switched in step S**13**. In other words, if the main microcomputer **31** is not provided with a signal from the brake switch **43** indicating that the brake is being depressed when the engine switch **15** is operated, the functional position is switched in the order of OFF, ACC, and ON (ignition ON). The starting of the engine and the switching of functional positions are performed only when the gearshift range is in the P range or the N range. Further, the starting of the engine and the switching of functional positions are performed only when the operation board **11** is exposed. That is, in the same manner as the gearshift operator **14**, the starting of the engine and the switching of functional positions are not performed when the operation board **11** is covered by the operation board cover **12** even if the engine switch **15** is operated. In other words, the main microcomputer **31** invalidates the engine switch **15** when the cover drive circuit **13** is not provided with the drive signal that exposes the operation board **11**.

[0050] Subsequently, in step S**14**, if the vehicle velocity is zero and the gearshift range is in the P range or the N range, when the engine switch **15** is operated in step S**14**, the engine is stopped in step S**15**. If a door is opened and closed after the engine is stopped in step S**16**, the vehicle controller **6** transmits the request signal in the passenger compartment in step S**17**. If the ID code signal cannot be received in response to the request signal in step S**18**, the vehicle controller **6** drives the cover drive circuit **13** to cover the operation board **11** in step S**19**. That is, when the main microcomputer **31** does not receive the ID code signal, the main microcomputer **31** provides the cover drive circuit **13** of the drive system operation apparatus **3** with the drive signal that moves the operation board cover **12** and covers the operation board **11** (as shown in the state of **FIG. 3A**).

[0051] This disables the operation of the gearshift operator **14** and the engine switch **15**. In the regular mode, when communication between the portable device **5** and the vehicle controller **6** is not established in the passenger compartment of the vehicle **1**, the operation board **11** is covered and the operation of the gearshift operator **14** and the engine switch **15** are disabled.

[0052] In step S**20**, the vehicle controller **6** transmits the request signal out of the vehicle **1**. If the ID code signal cannot be received in response to the request signal in step S**21**, the vehicle controller **6** locks the doors in step S**22**. That is, when the main microcomputer **31** does not receive the ID code signal, the main microcomputer **31** provides the door lock driver **44** with a lock drive signal to lock the doors. This returns the vehicle **1** to the state of step S**1**.

[0053] 2. Irregular Mode

[0054] In step S**31** of **FIG. 7**, the engine is stopped, the doors are locked, and the ID codes are not matched in the passenger compartment. In step S**32**, the vehicle controller **6** transmits the request signal out of the vehicle **1**. When the ID code signal from the portable device **5** is not received in response to the request signal in step S**33**, the vehicle controller **6** keeps the doors locked. When a door is unlocked, for example, by a mechanical key in step S**34** and the door is then operated (opened and/or closed) in step S**35**, the vehicle controller **6** does not transmit the request signal in the passenger compartment. This differs from the regular mode. That is, if the door is unlocked when communication with the portable device **5** is not established, the vehicle controller **6** enters an irregular mode and does transmit the request signal in the passenger compartment even if the door is opened.

[0055] The portable device **5** is inserted in the holder **21** of the key verification unit **4** in step S**36**. Then, in step S**37**, transponder communication is performed between the portable device **5** and the key verification unit **4**, and the key controller **23** performs transponder code verification. When the transponder code is verified, the vehicle controller **6** performs user verification with the image recognizer (step S**38**). When the user is verified, the vehicle controller **6** drives the cover drive circuit **13** to expose the operation board **11** of the drive system operation apparatus **3** (step S**39**). This enables the operation of the gearshift operator **14** and the engine switch **15**. In the irregular mode, the operation board **11** is exposed to enable the operation of the gearshift operator **14** and the engine switch **15** only when the portable device **5** is received in the key verification unit **4**. In step S**40**, the vehicle controller **6** enables the starting of the engine. In the same manner as in the regular mode, when the gearshift operator **14** is operated in this state, the connection of the transmission is switched accordingly.

[0056] When the engine switch **15** is operated in a state in which the starting of the engine is enabled in step S**41**, the vehicle controller **6** illuminates the instrument panel in step S**42**.

[0057] In the preferred embodiment, if the brake switch **43** is activated when the engine switch **15** is operated, the engine is started. If the brake switch **43** is inactivated when the engine switch **15** is operated, functional positions of the electric system in the vehicle **1** is switched (step S**43**).

[0058] Subsequently, if the vehicle velocity is zero and the gearshift range is in the P range or the N range when the engine is running in step S**44**, the engine is stopped when the engine switch **15** is operated in step S**45**. When the engine stops, the vehicle controller **6** causes the indicator **27**, which is arranged on the key cover **22**, to flash and the buzzer to go off. More particularly, the vehicle controller **6** provides the key controller **23** with an engine stop signal when the engine is stopped. When receiving the engine stop signal, the key controller **23** provides the indicator **27** with an activation signal to flash the indicator **27**. This informs the user that the portable device **5** is being received in the key verification unit **4** and prevents the driver from forgetting to remove the portable device **5**.

[0059] If the holder **21** of the key verification unit **4** is exposed when the indicator **27** is flashing, the key controller **23** provides the moving mechanism **26** with a drive signal to project the portable device **5** from the holder **21** in step S**47**. More specifically, for example, if the holder **21** is already in an exposed state when the engine is stopped, the key

controller **23** causes the indicator **27** to flash and the buzzer to go off and immediately projects the portable device **5** from the holder **21**. If the holder **21** is covered by the key cover **22** before the indicator **27** starts to flash, the key controller **23** causes the indicator **27** to flash and the buzzer to go off. Then, the key controller **23** projects the portable device **5** when the holder **21** becomes exposed. Normally, the key cover **22** is opened to expose the holder **21** when inserting the portable device **5** and when getting out of the vehicle **1**. Automatic projection of the portable device **5** when the driver wishes to get out the vehicle **1** makes the key verification unit **4** more convenient.

[**0060**] When the portable device **5** is projected from the holder **21**, the vehicle controller **6** drives the cover drive circuit **13** and covers the operation board **11** in step S**48**. More specifically, when transponder communication can no longer be established between the portable device **5** and the key controller **23**, the main microcomputer **31** provides the cover drive circuit **13** with a drive signal to close the operation board cover **12** and cover the operation board **11** (as shown in the state of **FIG. 3A**). This disables the operation of the gearshift operator **14** and the engine switch **15**. In the irregular mode, under the condition that transponder communication is not established between the portable device **5** and the key controller **23**, the operations of the gearshift operator **14** and the engine switch **15** are disabled.

[**0061**] When the door is locked by a mechanical key or the like in step S**49**, the vehicle **1** returns to the state of step S**31**.

[**0062**] The preferred embodiment has the advantages described below.

[**0063**] (1) To operate the gearshift operator **14** and the engine switch **15**, communication between the portable device **5** and the vehicle controller **6** or the key verification unit **4** must be established. Further, the image recognizer **46** must verify that the driver is the authorized user. That is, to drive the vehicle **1**, in addition to holding the portable device **5**, the driver must have his or her image registered beforehand. This prevents a third person from driving the vehicle **1** even if he or she is carrying the portable device **5**. Thus, basically only the user can drive the vehicle **1**.

[**0064**] (2) In the normal mode, that is, when the doors are unlocked through communication between the portable device **5** and the vehicle controller **6**, the image recognizer **46** is activated when communication is established between the portable device **5** and the vehicle controller **6** in the passenger compartment. In the irregular mode, that is, when the doors are unlocked by a mechanical key or the like, the image recognizer **46** is activated when communication is established between the portable device **5** and the key verification unit **4**. Accordingly, the image recognizer **46** is activated at different timings in the regular mode and the irregular mode. The image recognizer **46** is activated only when necessary in each mode. This prevents unnecessary activation of the image recognizer **46** and decreases the power consumption of the image recognizer **46**.

[**0065**] If the activation timing of the image recognizer **46** in the regular mode and the irregular mode were the same, for example, if the image recognizer **46** were to be activated after unlocking the doors in both modes, the image recognizer **46** would be activated regardless of whether or not the user gets into the vehicle **1**. In such a case, the image recognizer would be activated in an unnecessary manner and unnecessary power would be consumed.

[**0066**] (3) Subsequent to the opening of a door in the regular mode, the main microcomputer **31** activates the image recognizer **46** when transmitting the request signal in the predetermined area of the passenger compartment in the vehicle and receiving the ID code signal from the portable device **5**. Thus, the image recognizer **46** is activated only when the user enters the vehicle **1**. This reduces the amount of power consumed by the image recognizer **46**.

[**0067**] (4) The key cover **22** covers the holder **21**. If the key cover **22** is opened to expose the holder **21** when the portable device **5** is held in the holder **21** and the engine is stopped, the portable device **5** is automatically projected from the holder **21**. Normally, the key cover **22** is moved to expose the holder **21** when inserting the portable device **5** and when getting off the vehicle **1**. The automatic projection of the portable device **5** when the user get out the vehicle **1** makes the key verification unit **4** convenient and easy to operate.

[**0068**] (5) When the portable device **5** is inserted in the key receiver **21***a* of the holder **21**, the portable device **5** is automatically retracted into the holder **21**. This ensures and facilitates the retraction of the portable device **5** in the holder **21**. Thus, the key verification unit **4** is easy to operate.

[**0069**] (6) If the engine is stopped when the holder **21** is in an exposed state, the portable device **5** is automatically projected from the holder **21** as the engine stops. In other words, even if the vehicle is driven without closing the holder **21** with the key cover **22**, the portable device **5** is automatically projected when the engine is stopped. This makes the key verification unit **4** easy to operate.

[**0070**] (7) The operation board cover **12** covers the gearshift operator **14** and the engine switch **15**, which are operated to drive the vehicle **1**. This prevents a third person from operating the gearshift operator **14** and the engine switch **15**. Further, the gearshift operator **14** and the engine switch **15** cannot be seen from outside the vehicle **1**. This helps to lessen a third person's incentive to break into the vehicle **1** and improves the security level of the vehicle **1**. Further, the close location of the gearshift operator **14** and the engine switch **15** facilitate their operations.

[**0071**] (8) The operation board cover **12** does not expose the gearshift operator **14** and the engine switch **15** unless communication is established between the portable device **5** and the vehicle controller **6** or the key verification unit **4**. This prevents someone other than the user from operating the gearshift operator **14** and the engine switch **15** and improves the security level of the vehicle **1**.

[**0072**] (9) The parking switch **14***a* and the gearshift switch **14***b* operate the transmission, and the engine switch **15** starts and stops the engine. In comparison with the mechanical gearshift operator and engine operator of the prior art such as a gearshift lever and an ignition key cylinder, the parking switch **14***a*, the gearshift switch **14***b*, and the engine switch **15** have a more simple and compact structure. Further, the positions of the switches **14***a*, **14***b*, and **15** may be determined with a high degree of freedom.

[**0073**] (10) When the operation board **11** is covered by the operation board cover **12**, even if the vehicle controller **6**

receives an operation signal from the gearshift operator **14** or the engine switch **15**, the vehicle controller **6** invalidates the operation signal. That is, when the gearshift operator **14** and the engine switch **15** are in a covered state, even if the operation board cover **12** is broken and the switches **14***a*, **14***b*, and **15** are operated, such operation would not switch the gearshift range or start the engine. This further improves the security level of the vehicle **1**.

[**0074**] (11) The gearshift operator **14** includes the parking switch **14***a* and the gearshift switch **14***b*. Each of the switches **14***a* and **14***b* is associated with at least one gearshift range of the transmission. More specifically, when the parking switch **14***a* is operated, the gearshift range is switched to the P range, and when the gearshift switch **14***b* is operated, the gearshift range is switched to the P, R, N, or D range. Thus, the operation of the switch associated with the desired gearshift range easily and quickly switches the gearshift range. Further, regardless of whether the gearshift range is in the R, N, or D range, the parking switch **14***a* may be operated to immediately switch to the P range. This facilitates the switching of gearshift ranges.

[**0075**] It should be apparent to those skilled in the art that the present invention may be embodied in many other specific forms without departing from the spirit or scope of the invention. Particularly, it should be understood that the present invention may be embodied in the following forms.

[**0076**] Either the parking switch **14***a* or the gearshift switch **14***b* may be eliminated. For example, the parking switch **14***a* may be eliminated and the gearshift switch **14***b* may be used to switch the gearshift ranges between the P, R, N, and D ranges.

[**0077**] The gearshift operator **14** is not limited to the two switches, the parking switch **14***a* and the gearshift switch **14***b*, and may include three or more switches. For example, the gearshift operator **14** may include four push button switches, each corresponding to one of the P, R, N, and D ranges. This would enable switching to the desired gearshift range by operating the corresponding switch.

[**0078**] In addition to the parking switch **14***a*, an independent neutral switch for switching the gearshift range to the neutral range may be arranged on the gearshift operator **14**. Operation of the neutral switch would enable the gearshift range to immediately be switched to the N range regardless of the present gearshift range. An independent drive switch for switching the gearshift range to the D range or an independent reverse switch for switching the gearshift range to the R range may be arranged on the gearshift operator **14**. This would enable the vehicle **1** to be moved (forward or rearward) immediately after the engine is started. Further, erroneous operation resulting from forward or rearward movement of the vehicle **1** would be prevented. It is preferred that the gearshift range not be switched when operating the drive switch or the reverse switch unless the vehicle velocity is zero and the brake pedal is depressed.

[**0079**] The gearshift switch **14***b* does not have to be a lever switch and may be any kind of switch, such as a slide switch, a seesaw switch, or a rotary switch.

[**0080**] The drive system operation apparatus **3** does not have to be arranged in the instrument panel **2** between the driver seat and the passenger seat as long as it is located near the driver seat. For example, referring to **FIG. 1**, the drive system operation apparatus **3** may be arranged in a center console **9**, a portion **2***a* of the instrument panel **2** located near the driver side door, or a steering column **10**.

[**0081**] The gearshift range indicator **16** may be eliminated. In such a case, it is preferred that a gearshift range indicator **51** be arranged in the combination meter **8** as shown in **FIG. 1** to indicate the gearshift range.

[**0082**] The cover drive circuit **13** may be eliminated, and the operation board cover **12** may be moved manually. In this case, it is preferred that movement of the operation board cover **12** be disabled when communication is not established between the portable device **5** and the vehicle controller **6** or the key verification unit **4**.

[**0083**] The key cover **22** may be driven by a cover driver similar to the cover drive circuit **13** of the drive system operation apparatus **3**. For example, the key cover **22** may be closed to cover the holder **21** when the portable device **5** is either retained in the holder **21** or removed from the holder **21**. This would eliminate the need to manually cover the holder **21** and make it further easier to operate the key verification unit **4**. Further, this would avoid situations in which the driver forgets to cover the holder **21** and guarantees a high security level.

[**0084**] The starting of the engine may be enabled when the holder **21** of the key verification unit **4** is exposed. In other words, even if the holder **21** is exposed, the key controller **23** provides the main microcomputer **31** with an electric signal indicating that the transponder codes have matched (electronic signal enabling the driving of the engine) when transponder communication is established. However, the key controller **23** may prohibit the output of the electric signal, which enables the starting of the engine, until the key cover **22** covers the holder **21** even if transponder communication is established with the portable device **5**. This would enable the starting of the engine only when the portable device **5** is inserted in the holder **21** and the key cover **22** covers the holder **21**.

[**0085**] The key verification unit **4** does not have to be arranged in the instrument panel **2** between the driver seat and the passenger seat as long as it is located near the driver seat. For example, referring to **FIG. 1**, the key verification unit **4** may be arranged in the center console **9**, the portion **2***a* of the instrument panel **2** located near the driver side door, or the steering column **10**.

[**0086**] The combination meter **8** may indicate whether or not the portable device **5** is being held in the holder **21**.

[**0087**] The portable device **5** does not have to be provided with a transponder function. In this case, a further key provided with the transponder function is used in addition to the portable device **5**. The further key is retained in the key verification unit **4** to enable the vehicle **1** to be driven. In other words, the key verification unit **4** does not have to hold only the portable device **5** but may also hold a further key.

[**0088**] The image recognizer **46** may be activated when communication with the portable device **5** is established and the doors are operated (opened and/or closed) after they are unlocked. The image recognizer **46** may also be activated when a seat sensor, which is arranged in the driver seat, detects a person sitting on the seat. This would eliminate the

need for the vehicle controller outputting the request signal in the passenger compartment.

[0089] The image of the authorized user must be registered beforehand in the image recognizer **46**. In other words, when people other than the owner uses the vehicle **1**, everyone must be registered in the image recognizer **46** as an authorized user. To register someone other than the owner as the authorized user, it is preferred that an imaging device, such as a camera, be arranged in the vehicle facing towards the passenger seat. When the passenger seat imaging device images the same person a predetermined number of times, that person's image may automatically be recorded in the image recognizer **46** and be registered as image data of the authorized user. This would register a person sitting on the passenger seat a predetermined number of times as an authorized user and simplify user registration.

[0090] It is preferred that the image recognizer **46** use distinctive physical features of an authorized user, such as the face, eyes, hand, and fingerprints, to recognize an authorized user.

[0091] The present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein, but may be modified within the scope and equivalence of the appended claims.

What is claimed is:

1. A controller of a vehicle having an engine for use with an authorized key having a communication function, the controller comprising:

a microcomputer for controlling the engine, the microcomputer being capable of communicating with the authorized key;

a recognizer activated when predetermined conditions, including establishment of communication between the microcomputer and the authorized key, are satisfied to verify whether a vehicle occupant is an authorized user, the microcomputer enabling the starting of the engine when communication is established with the authorized key and the recognizer verifies the vehicle occupant as being the authorized user.

2. The controller according to claim 1, wherein the vehicle includes a passenger compartment, a door, and a key receiver arranged in the passenger compartment to receive the authorized key, the microcomputer transmits a request signal to a predetermined first area defined around the vehicle, and the authorized key outputs a response signal in response to the request signal, the microcomputer unlocking the door when receiving the response signal and entering a regular mode to activate the recognizer when the door is opened, the microcomputer entering an irregular mode to keep the recognizer inactivated when the door is unlocked even though the response signal is not received, and the microcomputer activates the recognizer in the irregular mode when communication is established with the authorized key received in the key receiver.

3. The controller according to claim 2, wherein the microcomputer transmits the request signal to a predetermined second area defined in the passenger compartment after the door is opened in the regular mode, and the microcomputer activates the recognizer when receiving the response signal from the authorized key in response to the request signal.

4. The controller according to claim 1, wherein the recognizer detects a distinctive feature of the vehicle occupant to verify that the vehicle occupant is the authorized user.

5. The controller according to claim 1, wherein the recognizer images the vehicle occupant to generate image data and compares the image data with reference image data that is registered beforehand.

6. A method for controlling a vehicle having an engine and a door, the method comprising:

transmitting a request signal to a predetermined area defined around the vehicle;

unlocking the door when receiving a response signal in response to the request signal;

verifying whether a vehicle occupant is an authorized user; and

enabling starting of the engine when the vehicle occupant is verified as the authorized user.

7. The method according to claim 6, wherein said verifying includes detecting a distinctive feature of the vehicle occupant and comparing the detected distinctive feature with reference data that is registered beforehand.

8. The method according to claim 6, wherein said verifying includes imaging the vehicle occupant to generate image data and comparing the image data with reference image data that is registered beforehand.

9. The method according to claim 6, wherein said verifying is performed after the response signal is received and the door is opened.

10. The method according to claim 9, wherein said verifying is not performed unless a predetermined condition is satisfied when the door is unlocked even though the response signal is not received.

11. The method according to claim 10, wherein the vehicle includes a passenger compartment and the predetermined condition includes establishment of transponder communication with an authorized key located in a key receiver that is arranged in the passenger compartment of the vehicle.

12. A system for controlling an engine of a vehicle having a passenger compartment, the system comprising:

an authorized key capable of wireless communication;

a key receiver arranged in the passenger compartment of the vehicle to receive the authorized key;

a recognizer arranged in the passenger compartment to image a vehicle occupant and verify whether a vehicle occupant is an authorized user;

a communication circuit that performs wireless communication with the authorized key;

a microcomputer connected to the recognizer and the communication circuit, the microcomputer activating the recognizer when wireless communication is established between the authorized key and the communication circuit, enabling starting of the engine when the recognizer verifies that the vehicle occupant is an authorized user, and disabling starting of the engine when wireless communication is not established between the authorized key and the communication circuit unless a predetermined condition is satisfied.

* * * * *